Building Services I

Lecture 7

Joints In Sewers

Coming to Joints in Sewers, suitable joints to be formed because to make the continuous sewer line we cannot have a complete line without any joints, so that will be decided by considering the material , the internal pressure and the external loads all those things, so by making the joint you have different types like

- Cement mortar joints
- Collar Joints
- Flexible or bituminous joints
- Mechanical Joints
- Open Joints

We will see each one in detail now

Cement Mortar Joints

- Cement mortar proportion 1:1 or 1:2 that will be inserted between the space of bell and spigot end. If you see the picture you can see this is where it is placed
- so that to maintain the alignment of sewers, the gaskets or packing pieces also will be placed. So that it is more compact and league proof.
- It is widely used in the construction of sewers and it is found to be satisfactory. Cement mortar joints are very common in Sewer joints.

Collar Joints

- The ends of the sewers are very plain here you don't have any type of bell or spigot, they are just placed near next one another and there is one collar here for one pipe which will be bigger than the other. The bigger diameter will be placed over the smaller one.
- So when it base space like this the ends of the collar that will be filled with the cement mortar again the proportion 1:1

Flexible or bituminous joints

- This is for used in sewer pipes which are larger diameter, then you have flexible and bituminous joints. Where bituminous used instead of cement mortar the material of joining substance will differ.

- It is flexible and adopted in place where there are chances of sewer settlements because the bituminous is the property of being in stretchable, so if there is going to be many settlement happening very rapidly we go for bituminous joints because cement mortar will crack when there is going to be settlements.

Mechanical Joints

- Mechanical Joints means by using flanged rings and bolts will be used so to keep two ends together. So it will be used for metallic pipes like cast irons and steel where you cannot use cement mortar for holding it together

Open Joints

- Now open joints are laid where even when there is the in filled ration okay if there is an in filled ration or if it is passing through dry ground, open joints can be adopted.
- So this ends of the sewer are placed together it will have a bell and spigot ends but the filling material will not be inserted in this type of joint that is the main aspect.
- The joints will be covered by tar paper or like gravel so that to prevent material entering into the sewer.

Now when we consider the joints and sewers, we saw the different types. Now what are the basic requirements why we need take so much of care doing joints and sewers.

Basic Requirements

- The construction and the laying of the sewer to be such that tree roots cannot penetrate through it because once it penetrates it will break and there will be leakage
- Then it should be capable of resisting the effects of acidic, alkaline or gaseous actions of the sewage like the sewage water which is passing through it as various alkalic and acidic properties. So those properties should not affect the sewer pipes.
- It as to be cheap and economical because we are going to be laying and for a very large area, it should be easy to construct like in the sense it should be easily handling should be easy and the labor should be able to construct easily with that and it is also has to be flexible and ager. Flexible in the nature at least was certain extent becausethere might be a slight settlements because we are going to lay the sewer line we are going to disturb the earth and the only we are going to lay the line. So there are going to be very slight settlement and it as to be flexible to even you know avoid the damage in those settlements.
- It as to be non-absorbent and durable like it should not absorb the material sewage which is inside so that it leaks through the material or anything that is outside should not come inside and it as to be durable, the durable means the life should be better.

- Reliable in the case here this is not easily broken or cracked by traffic or unauthorized persons. Sewage lines are also going to be below the line. So if there is going to be any traffic above the place where we are laying the sewers, the lines pipe should not get broken easily or it should be so strong enough the unauthorized person will can may damaged, so that shouldn't happen again.
- It should be watertight infiltration of ground water and exfiltration of sewage are prevented like I said it as be leak proof very simply put so that the ground water should not enter the sewer or the sewage should not go outside the out of the thing that is exfiltration

Ventilation of The Sewers

The sewage is whatever passing through we saw like it will have some acidic properties like alkyl properties, it also emits certain gases, unfavorable gases so we have to be having it ventilated properly mainly for two reasons one is continuous flow and other is the disposable of sewer gases.

Continuous Flow

So this ventilation is like to prevent the escape of noxious gases, it will have a continuous flow in them, if we have into continuous flow the gases will not escape because it is going to keep on, it is going to stagnant then the order the gases will leak and the surface of the sewage should remain in contact with free air, otherwise air locks will formed and block the flow. So it should not be like if it is passing through pipe or something there should be enough free air space, so that there is no air lock will happen within the lines.

Disposal of Sewer Gases

The decomposition of the sewage will develop some sewer gases that we already I told you, these gases are certainly harmful so they have to be carefully disposed of to the atmosphere, you cannot let it just like that so we have to take care of this two reasons we have to make sure that proper ventilation is there for sewers and there is also the disposal of sewer gases, particular gases like methane they are very highly explosive, so if you don't properly ventilated the manhole covers chances are there they can be blown off, blown on the sense it will be exploded. So this gases are very light in weight, so they always move upwards, so when they move upwards when we don't take proper measures it will makes with normal air and air pollution will happen.

Methods of Ventilation

Now for ventilation we have various methods like some six methods are listed here

- Manholes with chemicals
- Manholes with gratings
- Proper construction of sewers
- Proper design of sewers
- Proper house drainage system
- Ventilating columns or shafts

Now how do we do what is the usage of each method is when

Manholes with Chemicals

We place chemicals in the manhole covers, so when the gas is coming up, the chemical will react with this gases and it will rented them harmless. So it is very costly and it is very rarely adopted.

Proper construction of sewers

It should be laid at such a gradient that self-cleaning velocity is developed so there is the continuous flow so when you lay the sewers it has to be the particular gradient things nothing but it slope. So it as to be on a very mild slope so that the self-cleaning velocity in the speed with a flow is some that is will clean of the older sewage that is collected there so this will ensure the continuous flow stagnation there will be no emission of gases

Manholes with gratings

- These Manhole covers they are provided with small gratings means small openings will be there and through which the sewer gases will escape and this is the very simple method
- This will cause air pollution, so it is adopted only in isolated places where there is no public nuisance where it will not cause a public nuisance, if it is a very isolated place we can use the gratings or the manhole covers,
- But the disadvantage will be permit road dust to come inside because there is the hole if it is go one way, the other way it is also it will come in, so the road dust come inside, storm water to enter the sewer, so these are the disadvantages when you provide gratings

Proper design of Sewers

- So when you design if itself like how we are water sub material are going to use, what is the size we are going to use , when you design itself you to run either it should be

two-thirds or one half and the remaining top space will be for the accumulation of sewers that is you have the space inside the pipe itself, so this is why we do this is

- It affords proper ventilation
- It allows the escape of sewer gases which are liberated by biological degradation

So this is the natural method of when the design itself we can bring it ventilation in the sewers

Then the other point is like

- This proper design itself you can avoid the pollution of underground water because exfiltration might happen if it is going to go the full load is going to go in the pipe so you can avoid that
- If it is going to be very full you will not get the gravity flow, I told you there should be a slide slope where in you can it can be self-cleansing velocity will be achieved but that will not happen if it is going to be the full load.
- It minimizes the corrosion of sewers, give that space the corrosion of the sewer pipes will be less and also prevents the succession of underground waters
- So when there is going to be air pressure inside the ground water coming inside the sewer will be prevented

Proper house drainage system

The house drainage system itself you designed properly we can have proper ventilation that is

- The lateral sewers are vertically ventilated independently by suitable provision of ventilating shafts or columns. We call it as cowl in a colloquial term. So if you see the pipes which is coming out the same pipe will be taken vertically and above the height of the building and there you have the ventilation system in that, those things are called ventilation shafts or columns
- So these gases are carried in these columns and it is relieved in the atmosphere and these lines will be above the height of the building, so there is no public nuisance because of air pollution.

Ventilation shafts or columns

- The ventilation separate shafts or columns constructed for ventilation of the sewers, they are formed by joining cast-iron or steel pipes. So it is not a masonry construction, you take cast iron or steel pipe and make a ventilation shaft or column,.
- So it is placed at a distance of about 60m -150m along the sewer line. So this is not done for individual buildings along the sewer line spacing of 60m -150m these columns will be placed.

- So but this column cannot stand on, so you provide a foundation block at the bottom and you make it to stand and at the top you provide a cowl so the gases will escape. So the gases whichever in these sewer lines it will be escaping to the atmosphere and the safer height and also
- when we are doing this ventilation shafts or columns you have to consider the internal diameter of the shaft, the internal diameter it should be the one third the diameter of the sewers at least it should not be less than that
- Joint of pipes must be alright to prevent leakage of sewer gases again when we say the column the pipes and art going to be of whole piece so it is going to be jointed because it is going to beyond the height of the buildings, so when you joint it even the ventilation column as to be airtight so the gases doesn't come out of these joints, so the unpleasant odors causing nuisance you can stop these unpleasant odor in the surroundings area. Other things are like location it as to be located so such that it sunshine's in the major portion of the day and this heat will increase the circulation of the air
- The top of the ventilation shaft has to be covered with wire mesh this is like that is called cowl to prevent the birds from entering into the nest because the grating will be bigger in size. So those openings has to be covered with the wire mesh
- The ventilating columns should be higher than the height of nearby structures that we already saw

Septic Tank

These are the sewer lines how it as to be designed, what are the things as to be done we saw. Now coming to septic tank this thing like basically provided in areas where you there is municipal or the corporation, the governing authority is not able to provide any sewage disposal methods. So we do individually than the premises and it is taken to the pumping plant. So that is called the septic tanks.

- It is basically sedimentation with some degree of solid destruction due to sedimentation and subsequent anaerobic digestion. So it a sedimentation tank which means like the sewage is collected into the tank where it is settles down, sedimentation it will kept at rest, so that the heavier particles will go down that it will settle down and by settling down itself a certain solid destruction happens here and then next process here anaerobic digestion we will see this in detail
- This is suitable for isolated or undeveloped areas as I told you of locality municipals were not laid or no facility to convey and to treat the sewage, so you are not able to treat the sewage also immediately. So in public sewage systems units or plants like you

do it in your public sewage system, you don't have a sewerage treatment plant. So these two are the main reasons to go for septic tanks.

DESIGN ASPECTS

CAPACITY

So the flow and characteristics of wastewater they are like as per you see this average flow capacity is 100 -160L per day whereas the peak flow capacity is 170-270L per day, so when we consider this two depending on the usage and the people using their and we will decide on the flow, then you have BOD per capita is 0.045kg per day, so this are all given for a day and the last thing you have sludge accumulation per capita for the year they are given, so taking this how many days you want to store and how much of things you want to collect in the septic tank will be designed.

DETENTION PERIOD

Detention Period is the time till when the sewage water as to be kept inside the septic tank.

- So they are originally designed for 24hr liquid retention time at average daily flow. So when you take the average flow per capita they will take this 100 -160L per day, so that will be taken one person depending on the number of person using you calculated and for a 24hr and it will be liquid retention time will be taken.
- So considering the volume required for sludge and scum accumulation, the septic tank can be designed for waste water retention time of 1 to 2 days. So this 24hr is for liquid retention so now we have to also consider the solids inside the sewage thing, so you consider 1 to 2 days' time, so you design the time so it can hold 1 to 2 days of an amount of flow.

When you design this you have to make sure that there should be a free board, free board is this space above the tanks, so the has to be some air space left in the tank so that has to be 400 to 600mm and the shape will be generally rectangular in shape like the ratio of 2:4. When you see here this is the basic septic tank so this is your inlet chamber, this is in plan that is you see it from the top, this is the inlet chamber you have baffle valve here which will initially like be a screening wall and you have this is your tank where it is made to settle down this is the sedimentation tank and then you have this will be after sedimentation, the liquid will be taken out here and this scum will be taken out, so this is the section you see it comes enters here, it is kept here sedimentation happens, so this is slopes slightly so that you can accumulate the sludge here and then you have the opening here through which the water will come out and you can take it out. Then the constructional features so when you do a septic tank it can be done like from any masonry concrete or brick masonry or fiber glass, nowadays we have a fiber

glass readymade septic tanks available like your overhead water tanks, so two of rectangular shape and later circular shape, fiber glass comes in a circular shape, the concrete or brick missionary comes in a rectangular shape.

The direct currents should not be established between inlet and outlet, this is achieved by using the baffle walls or submerged like you see here I told you we have baffle walls here, so this is your inlet and this is your outlet so this should not our direct connection like whatever is coming inside the inlet should not go through the outlet we have to sediment here, so we provide a baffle wall here as well as here so that there is to ensure the sedimentation takes place.

The scum boards it is provided near the inlet and outlet ends to prevent the escape of the scum. You can see there is the before this openings this is inlet and this is outlet so before this two you have another scum board, scum is the final sludge so that should escape only the water can be taken out from the septic tank and septic tank should be properly ventilated. The top cover usually made of R.C.C because usually this is the underground you can use the space the top of generally we use it for parking or something like that. So that will be made it of R.C.C and you will have a manhole, so that is for maintenance purpose, for inspection and cleaning of the tank.

Constructional Features

- Then it has to be before you start using or commissioning the septic tank it has to be filled with water, ok you should not be dry and you should not let it because the flow speed has to be maintained.
- The effluent of tank should be properly disposed off, the effluent is the sedimented particles has to be disposed of direct discharge of effluent into natural waters should be discouraged.
- This effluent should taken out from the tank should not be discharged into the natural waters directly it has to be treated and then only you can discharge it.
- Sludge: Sludge is allowed to be accumulated at the bottom of the tank and must be removed at the intervals either by manual labour or by pumping. I told you bottom of the tank there you have the sludge. So that has to be removed by the manual labour or by pumping also you can do it, it has to be done periodically at intervals
- For large septic tanks, the sludge removal pipe is provided which leads to the nearby sump which is pumped periodically or removed. IF the septic tank is very huge for a removal of sludge also additional pipe will be provided from there you can remove the sludge directly to the scum.

- Accumulation of sludge at the bottom of the tank decreases its storing capacity, so now when the sludge is going to keep on settling another storing capacity is going to go down, so we have to clean it at least every 6-12 months.
- So for this purpose what they do is the tanks may be constructed in series that is why we have to compartments so the one thing will be for sedimentation and goes to the next part two stage sludge digestion tanks, but single tanks stage are also there.
- Now when we take single tank the combines the function of sedimentation tank and the sludge digestion tanks and how do we dispose the affluence which is inside the septic tank

Disposal of Effluent

- So it is highly odorous, it is highly smelly because it is stagnant so it has to be carefully discharged.

What are the methods we have

- Absorption trenches
- Gardening
- Natural waters
- Soak pits
- Soak wells
- Sub-surface irrigation
- Surface irrigation
- Trickling Filters.

Absorption Trenches

This is like your gardening where they make trenches in the backyard of your house, so this trenches will be like trenches is like a hollow pit, so it will be a layer of broken stones will be laid inside it that is for the filtration purpose. The effluent of the septic tank when placed in absorption trenches after of period time it will be observed by the ground and then it will not be harmful.

Gardening

This effluent of the septic tank they use it in gardening purpose also, it works as a goodmanure. So but we have to take care that when you dispose this or use it as a manure, it is not a danger to the nearby residents it has a very harmful substances within it

Natural Waters

You can dispose off it is natural waters but it has to be diluted and it has to be neutralized all the threads has to be neutralized.

Soak Pits

- Soak pits are nothing but you will have a circular pits, hollow pits will be there, so circular pits varies from 1.2m t0 1.8m.
- The effluent will fall in to the pit, now this is what we talk about this is will be like it will be hollow not much of depth, so the effluent is the inlet visual fall on to the pit. So now after it is left there for some time and it will get soaked and absorbed by the surrounding soil.
- So these pits will be can be either empty or can be filled again with the filtration like broken brickbats or any stones filled inside that's the second picture you can see here, so this one is empty or it can be filled pit with your lining brickbats or stone pieces, broken pieces of stone which we are not going to use it.
- So this thing will absorbs the effluent and dispose of the surroundings areas.

Soak Wells

- Soak well is similar to soak pit but the size will be huge.
- So this is like the depth will be more around 3m
- This is the efficient method they say for effluent disposal

Sub-surface irrigation

- When the soil is going to be very porous, you can use a sub-surface irrigation
- So the effluent will be conveyed and discharged through underground drains with open joints like you will have similar to your here is the septic tank and from here the effluent is taken to the soil absorption system. This is your irrigation sub-surface disposal is come here it goes on because the soil is porous water will get absorbed like how we pour water on sand surface like that

Surface Irrigation

This is surface irrigation, previously we saw sub-surface irrigation, surface irrigation is if it is have some fertilizing value they just can be utilizing sewage forms we call it as sewage forms it will be diverted o that that will act as manure or fertilizer for the farms.

Trickling filters

This will improve the quality of effluent of septic tank; it is sometimes allowed to pass through tricking filters before its final disposal. Trickling filters we saw in this previous videos like it will

be a mission where it will be a rotating hum and the sewage water will be repelling from down and bottom again will have this broken stones and birds as the bet, so this is the slope process of settling the water to settle down, this is what the trickling filter looks like, this is actually a circular thing where you had this boom, boom will be single kind of rod from here you have the effluent coming inside and then it comes to the boom and it trickles from here, so this is the way trickling filters works. So this works on the properties of aerobic digestion which is aerobic bacteria act on the effluent and convert it into harmless liquid. So when the sewage is being trickled or when it comes down it drops to the surface of the tank what happens is by the time aerobic, aerobic is bacteria which is present in the atmosphere as it is so that will work on the effluent and it convert into harmless liquid. So this can be directly discharged into natural waters also or it can be even applied to land it can be used as a water for gardens.

Advantages

So what are the advantages of using septic tank you can see

- You do not require any special attention or skilled supervision can be done easily constructed.
- The cost is reasonable when we compared to advantages
- Now the performance of a properly constructed septic tank is very good, it is removed about 90% of BOD and 80% of suspended solids.
- So there is also the absence of any moving parts. There is no any mechanical part involved at all
- The advantages is being in like the reduction in volume of the sludge will be reduced and about 60% less in volume and 30% less in weight

Disadvantages

- It is not for functioning properly, the effluent will be very dark and foul-smelling
- The excessive large size is required if there are more people are going to be there
- Leakage of gases is possible
- Occasional removal of sludge will be like increase the maintenance cost.